Postdoctoral Fellowship Highlight

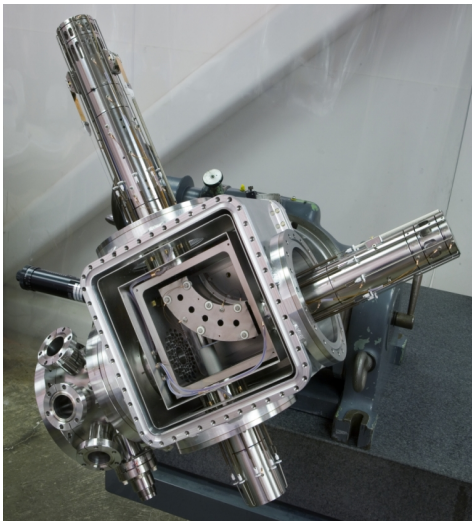
Chris Jozwiak, Ph.D., Physics

Years of Fellowship: 2009-2012
Collaborating Institution: University of California, Berkeley
Currently: Staff Scientist, Advanced Light Source

Project: **Development of high-spin ARPES**

As an ALS Postdoctoral Fellow, Chris Jozwiak aided in the development of two burgeoning frontiers of angle-resolved photoemission spectroscopy (ARPES) techniques: high resolution spin-resolved ARPES and pump-probe time-resolved ARPES.

As interest in the spin degree of freedom in solids continues to grow, the condensed matter community has become increasingly in need of direct experimental probes of the spin-dependent electronic structure of various complex and advanced magnetic material systems. While standard ARPES has been heavily invested in with remarkable success, spin-resolved ARPES has had fewer advancements and has been a weak-point of our toolkit. Other than at NSLS, which has since shut down, there were no dedicated spin-resolved ARPES endstations in operation at any third-generation synchrotron in the U.S.



While a graduate student at UC Berkeley, Chris began a joint project with the ALS to develop a novel spin-resolved photoelectron spectrometer utilizing low energy exchange scattering and time-of-flight (TOF) spectroscopy. Continuing as a postdoctoral fellow, he fully commissioned the "spin-TOF" instrument at multiple ALS beamlines and demonstrated performance unique in the world. With the "spin-TOF", Chris led a number of collaborative projects, including investigations of the spin structure of topological insulators, spin-polarized core-level emission, spin-dependent signatures of bosonic coupling in ferromagnets, and signs of magnetism in graphene based systems.

In addition, Chris worked closely with Alessandra Lanzara's (UC Berkeley and LBNL MSD) laser-based ARPES laboratory next door to the ALS. There he successfully integrated the "spin-TOF" with a 6 eV laser system, expanding its use beyond the limited "2bunch" operating modes at

the ALS. The resulting powerful combination quickly enabled unique research in topological insulators and the observation of novel spin manipulation effects in the photoemission process.

In the laser lab, Chris also helped develop a high-resolution pump-probe based ARPES system and researched quasiparticle recombination dynamics in high temperature superconductors. The success of these two projects led him to begin work on an LDRD proposal to leverage the strengths of the "spin-TOF" and the laser system to develop an approach to simultaneous time- and spin-resolved ARPES as a powerful probe of spin dynamics.

The ALS Postdoctoral Fellowship enabled Chris to develop his skills as both an instrumentalist and a scientist in an environment that highly values both. Chris was recently hired as a beamline scientist at the ALS for the MAESTRO beamline to aid in the development of nanoARPES capabilities and unique combinations of *in-situ* sample synthesis and characterization techniques.

Selected Papers (2009 - 2012)

1. *"Photoelectron spin-flipping and texture manipulation in a topological insulator."* **C. Jozwiak**, C.-H. Park, K. Gotlieb, D.-H. Lee, S. G. Louie, J. D. Denlinger, C. R. Rotundu, R. J. Birgeneau, Z. Hussain, and A. Lanzara; *accepted,* Nature Physics

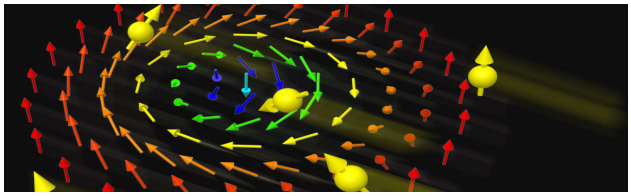
2. *"A new spin on ARPES."* **C. Jozwiak**, A. Lanzara, and Z. Hussain; ***Synchrotron Radiation News*, 25**, 32 (2012). (Invited article)

3. *"Tracking cooper pairs in a cuprate superconductor by ultrafast angle-resolved photoemission."* C. L. Smallwood, J. P. Hinton, **C. Jozwiak**, W. Zhang, J. D. Koralek, H. Eisaki, D.-H. Lee, J. Orenstein, and A. Lanzara; ***Science* 336**, 1137 (2012).

4. *"Widespread spin polarization effects in photoemission from topological insulators."* **C. Jozwiak**, Y.L. Chen, A.V. Fedorov, J.G. Analytis, C.R. Rotundu, A.K. Schmid, J.D. Denlinger, Y.-D. Chuang, D.-H. Lee, I.R. Fisher, R.J. Birgeneau, Z.-X. Shen, Z. Hussain, and A. Lanzara; ***Phys. Rev. B* 84**, 165113 (2011).

5. *"Nodal quasiparticle meltdown in ultrahigh-resolution pump-probe angle-resolved photoemission."* J. Graf*, **C. Jozwiak***, C.L. Smallwood, H. Eisaki, R.A. Kaindl, D.-H. Lee, and A. Lanzara; ***Nature Phys.*, 7**, 805 (2011).

6. *"A high-efficiency spin-resolved photoemission spectrometer combining time-of-flight spectroscopy with exchange-scattering polarimetry."* **C. Jozwiak**, J. Graf, G. Lebedev, N. Andresen, A.K. Schmid, A.V. Fedorov, F. El Gabaly, W. Wan, A. Lanzara, and Z. Hussain; ***Rev. Sci. Instrum.* 81**, 053904 (2010).



Spin graphic from School of Engineering, The University of Tokyo (www.t.u-tokyo.ac.jp/etpage/release/2012/20120808.html)